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United States Government Accountability Office
Washington, DC 20548

May 18, 2005

The Honorable Terry Everett
Chairman
Subcommittee on Strategic Forces
Committee on Armed Services
House of Representatives

The Honorable Silvestre Reyes
Ranking Minority Member
Subcommittee on Strategic Forces
Committee on Armed Services
House of Representatives

Subject: Department of Defense Initiatives on High Energy Lasers Have Been Responsive to Congressional Direction

Congress directed the Department of Defense (DOD) to prepare a master plan to develop laser technologies for potential weapons applications in the National Defense Authorization Act for Fiscal Year 2000.[1] In response to this legislation, the High Energy Laser (HEL) Executive Review Panel was formed and issued the HEL Master Plan on March 24, 2000. This plan recommended that DOD implement a new management structure for HEL technologies and increase the funding allocated to HELs to achieve a better balance between large demonstration programs and the enabling science and technology projects. Subsequently, in the Floyd D. Spence National Defense Authorization Act of Fiscal Year 2001, Congress directed the Secretary of Defense to implement the management and organizational structure specified in the Master Plan.[2]

You asked us to review the extent to which DOD has implemented the recommendations of the HEL Master Plan, by assessing (1) whether DOD has achieved more balance between large demonstration projects and the

[1]Pub. L. No. 106-65, sec. 251.

[2]Pub. L. No. 106-398, sec. 242.

enabling science and technology base projects; [3](2) whether the DOD funding process focuses on the most critical HEL issues; and (3) what impact the new management structure has had on the coordination and redundancy of HEL technology efforts DOD-wide. We briefed your staff on October 20, 2004, on the interim results of our work, and, at that time, we agreed to provide a briefing on the results of our work with a letter summarizing our findings to follow. We provided the final briefing on March 30, 2005. This letter summarizes and transmits the final briefing itself (see encl. I).

In addition, the conference report that accompanied the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 directed the Secretary of Defense to submit a report to Congress on the implementation of the fiscal year 2001 legislation.[4] The conferees required the Secretary to provide this report by January 15, 2005, and also asked us to review the report and provide our assessment of it to the congressional defense committees by March 15, 2005. As of March 30, 2005, the Secretary had not issued this report, and we were unable to review the report in time to include our assessment in this correspondence. We will provide this assessment to your staff and to the other defense committees in a separate letter within 60 days after the Secretary issues the report.

Background

The HEL Joint Technology Office (JTO) was formed in June 2000 as the principal organization to implement the recommendations of DOD's HEL Master Plan. It functions as the advocate for DOD's HEL technology development and funds high priority science and technology efforts that are expected to have significant impact on long-term laser weapon requirements of the military services. In addition to the HEL projects sponsored by the JTO, each of the military services, the Missile Defense Agency, and the Defense Advanced Research Projects Agency sponsor HEL science and technology efforts. The Army,[5] the Missile Defense Agency, and the Special Operations Command are also working on large-

[3]The large demonstration programs are system-specific programs, such as the Airborne Laser or the Advanced Tactical Laser, while the enabling science and technology base projects are somewhat independent of a specific application.

[4]H.R. Conf. Rep. No. 108-767 at p. 520.

[5]The Army did not request funding for its HEL weapon program, the Mobile Tactical High Energy Laser in its fiscal year 2006 budget request. According to an Army official, the program's priority was insufficient to compete favorably with other Army programs.

scale HEL demonstration programs with the goal of fielding laser weapon systems.

The HEL Master Plan recommended that the funding for HEL science and technology be increased to achieve a better balance between large demonstration programs and the enabling science and technology projects. In discussing the imbalance between these projects, the plan stated that, while the demonstration programs are desirable to demonstrate that the HEL weapons can be fielded, there must be a corresponding level of science and technology base funding to ensure the future growth of these programs and the continuing exploration of other types of HEL technologies. Currently, all DOD HEL activity, including the demonstration programs, is funded within the science and technology budget category, which includes basic research, applied research, and advanced technology development.

The Master Plan also recommended that DOD establish a new management structure for HEL technologies. Therefore, the HEL Technology Council was established, with the Deputy Undersecretary of Defense for Science and Technology designated chairman of the council and senior civilian official for HEL projects. In addition, senior level executives of the services and agencies were designated as the members of the Technology Council. The HEL Technology Council provides oversight and approval authority over JTO funding, while Technology Council executives represent their individual service and agency needs and bring guidance to their respective service based on the council's deliberations. The JTO consists of a director and full- and part-time representatives of each service or agency, with additional support provided by technical area working groups, which provide recommendations and expert advice to the JTO on their projects.

Results in Brief

We found that the Department of Defense has, in large part, implemented the recommendations of the High Energy Laser Master Plan and has made the following changes to increase the focus on critical high energy laser issues:

- Since the High Energy Laser Master Plan and the 2001 Defense Authorization Act, the overall investment in high energy laser efforts has increased and the science and technology base has grown as a proportion of total investment.

- The Joint Technology Office has a process for establishing priorities that is clearly defined, objective, and based on input from experts in the high energy laser field. The services and agencies fund their high energy laser projects according to their mission requirements.

- By implementing the management structure and recommendations of the Master Plan, the Department of Defense has increased collaboration within the high energy laser community and provided more opportunities for coordination of high energy laser efforts.

The DOD had no comments on a draft of this report.

Efforts to Implement Congressional Directives

From a resource standpoint, DOD has achieved more balance between its spending for large-scale HEL demonstration programs and the enabling science and technology base projects. Since the HEL Master Plan was written and the subsequent legislation implemented, the overall investment in HEL efforts has increased and the science and technology base has grown as a proportion of the total investment. In 1998, the HEL technology base accounted for 17 percent of the total HEL spending ($66 million out of $398 million, with the demonstration programs receiving $332 million). In 2004, it increased to 27 percent of total HEL spending ($263 million of $983 million, with the demonstration programs receiving $720 million). This 27-percent increase includes about $58 million to fund the JTO and its projects as well as an increase in service and agency funding for HEL science and technology base projects, from about $66 million in 1998 to about $205 million in 2004. We did not attempt to determine what constitutes the ideal spending balance between demonstration programs and science and technology base projects, nor did we attempt to analyze the projects for technical balance.

For the new money that the JTO has infused into enabling HEL science and technology projects—ranging from about 20 to 40 percent of the total—the funding process does track with identified HEL priorities. While the individual services participate in this process, they fund their own science and technology projects based on their specific needs. The JTO has a process to evaluate projects that includes criteria for establishing funding priorities for the most critical technical issues. These criteria are clearly defined, objective, and based on input from a wide range of experts in the HEL field. In deciding on which projects to fund, the JTO uses the priorities established through this process. The JTO initiated the process in 2000 and continues to follow it when allocating funding for its laser projects. The JTO used four criteria to prioritize technology projects critical to future HEL applications: the overall potential impact on HEL

missions; whether the technology is sufficiently mature to benefit from increased funding; whether the funding needed for the research matches the expected JTO funds; and whether there are benefits to multiple applications or multiple services. The HEL technology projects were then evaluated by a wide-range of experts in the HEL field, prioritized and grouped into seven technology thrust areas: beam control, solid-state lasers, chemical lasers, free-electron lasers, advanced laser technology, lethality science, and modeling and simulations. The JTO allocates its funding, which has been between $50 million and $60 million each year since fiscal year 2002, exclusively to projects in these seven thrust areas. The priorities and the investment strategy are updated annually. The services and agencies prioritize and fund their technology investments according to their individual mission needs. However, they do so with the knowledge of what the JTO and other organizations have underway.

By implementing the management structure and recommendations of the 2000 HEL Master Plan, DOD provides opportunities via the Technology Council and the JTO's Technical Area Working Groups for more collaboration among the HEL community as well as opportunities for key HEL experts from all of the services to discuss goals and objectives and share project information. The Technology Council provides specific direction to the JTO and some direction to the services and agencies on their HEL-related activities. The senior level executives on the Technology Council represent their services' or agencies' HEL needs and issues to the council and take the results of the Technology Council discussions and guidance back to their own services. Finally, based on our review of selected projects, we found no apparent duplication of HEL technology projects within the JTO projects or among the JTO projects and service and agency projects. Even within the same thrust area, the projects explore different aspects of the various technologies. According to JTO officials, the office makes a conscious attempt to avoid duplication with service or agency projects and instead tries to address technology gaps and issues not being covered by the services and agencies.

Agency Comments and Our Evaluation

The Department of Defense reviewed a draft of this report, but had no comments on the content. Their response is included as Enclosure II.

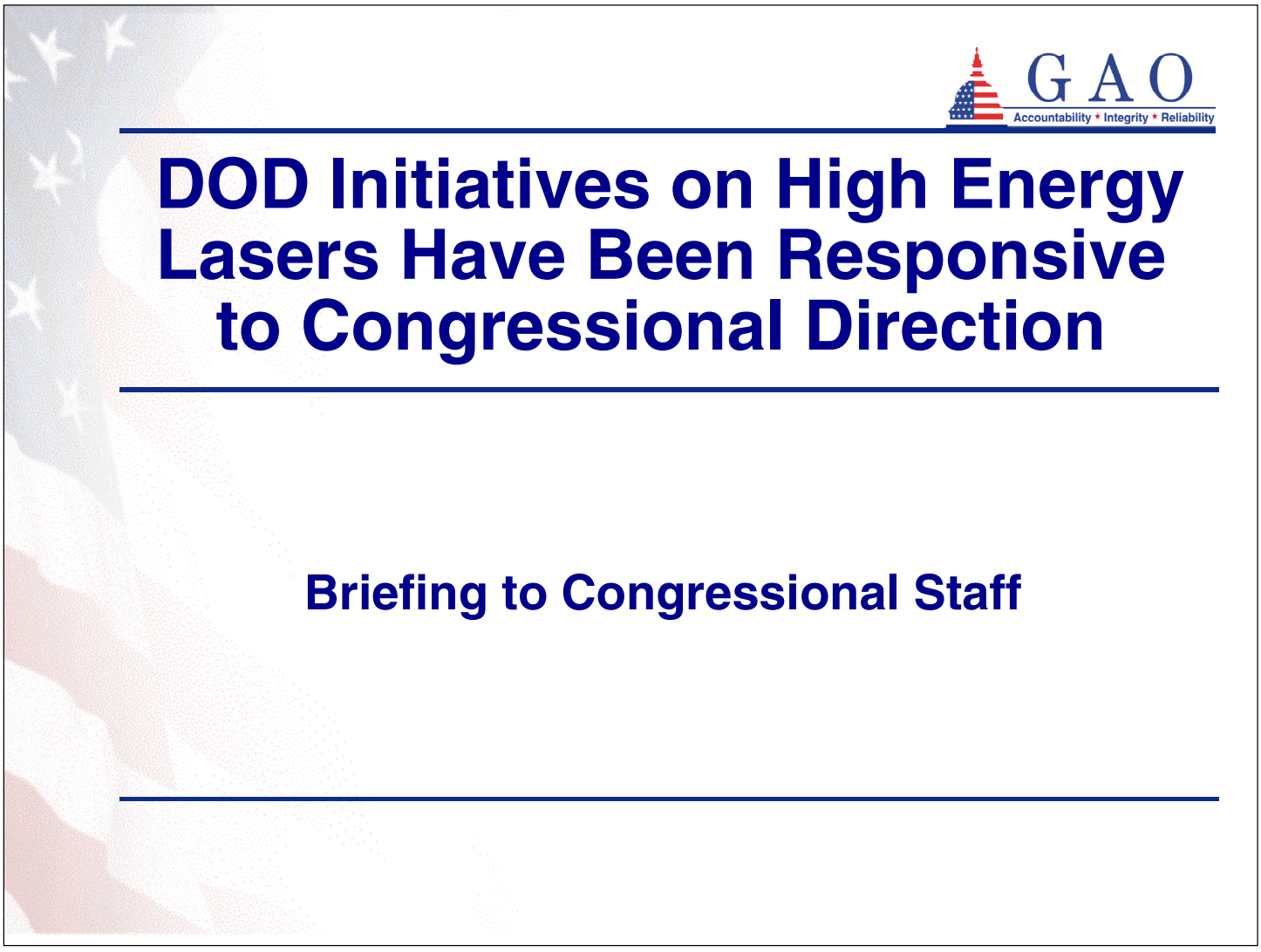
Scope and Methodology

We reviewed the HEL Master Plan and the subsequent legislation as well as other documentation concerning the implementation of the recommendations in the Master Plan. We interviewed officials within the Office of the Secretary of Defense to assess DOD's implementation of the plan's recommendations. We interviewed HEL JTO officials and reviewed documents to determine their role in implementing the Master Plan's recommendations and to assess their criteria for prioritizing and funding HEL technologies. We also interviewed Army, Navy, Air Force, Missile Defense Agency, and Defense Advanced Research Projects Agency officials involved in HEL projects and reviewed pertinent documentation to determine how the officials set their priorities and funding for HEL projects and to solicit their views on the effectiveness of the JTO as the focal point for HEL-related activities. We reviewed the active projects the JTO was sponsoring for possible duplication with those from the services and other agencies. For those projects that seemed similar to other projects, we then did a more in-depth analysis of the project and its focus. We conducted our review from August 2004 to April 2005 in accordance with generally accepted government auditing standards.

Paul L. Francis, Director
Acquisition and Sourcing Management

Enclosures - II

Enclosure I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DOD Initiatives on High Energy Lasers Have Been Responsive to Congressional Direction
Briefing to Congressional Staff

Background

- National Defense Authorization Act for Fiscal Year 2000 (sec. 251) directed DOD to prepare a master plan to develop laser technologies for potential weapons applications
- In response to this legislation, the High Energy Laser (HEL) Executive Review Panel was formed and issued the HEL Master Plan on 3/24/2000, which recommended that DOD:
  - Increase funding allocated to HEL Science & Technology (S&T) to achieve a better balance between large demonstration programs and enabling S&T projects
  - Implement a new management structure for HEL Technologies

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Background

- Subsequently, in the Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001(sec. 242), Congress directed the Secretary of Defense to implement the management and organizational structure specified in the High Energy Laser Master Plan
- HEL Joint Technology Office (JTO) was formed in June 2000, as principal organization to implement the Master Plan's recommendations

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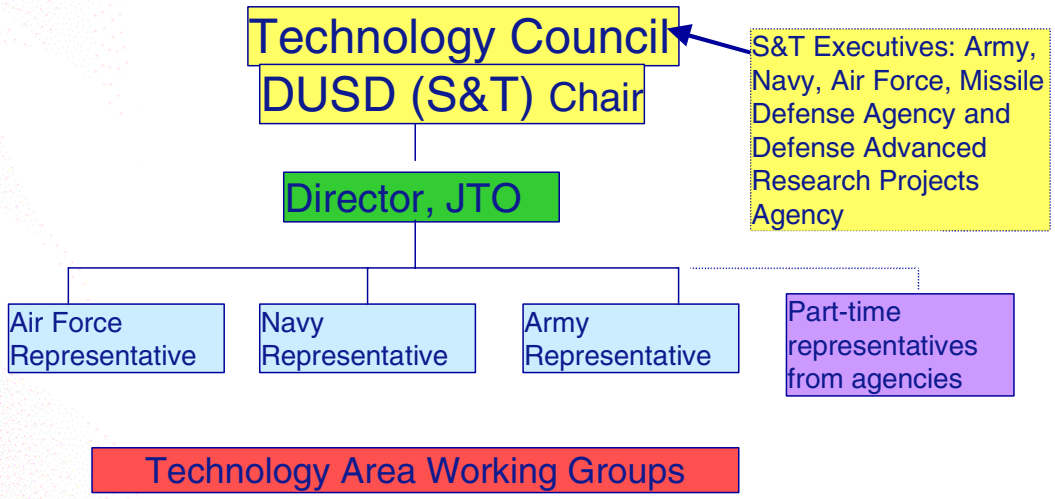
Background: Management Structure for High Energy Laser Programs



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Background: DOD's New Management Structure for HEL-Related S&T

- The Deputy Undersecretary of Defense for Science and Technology (DUSD, S&T) was designated senior civilian official for High Energy Laser programs
  - Chairs the Technology Council
  - Senior S&T executives from services, Defense Advanced Research Projects Agency, Missile Defense Agency, and the Defense Threat Reduction Agency serve on the Technology Council

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Background: DOD's New Management Structure for HEL-Related S&T

- The HEL JTO was formed in June 2000
  - Consists of the Director, full-time representatives from the services and part-time representatives from agencies
  - Technology Area Working Groups, comprised of members of services, along with industry representatives, provide technical advice and support to the JTO

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Three Objectives of GAO's Review

- Has DOD achieved a better balance between large demonstration programs and enabling S&T projects?
- Does the DOD funding process focus science and technology efforts within the HEL community on the most critical technical issues?
- What impact have the HEL Technology Council and JTO had on the coordination and redundancy of the HEL technology development efforts DOD-wide?

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Results in Brief

- Since the HEL Master Plan and the 2001 Defense Authorization Act, the overall investment in HEL efforts has increased and the science and technology base has grown as a proportion of total investment.
- The JTO has a process for establishing priorities that is clearly defined, objective, and based on input from experts in the HEL field. The services and agencies fund their HEL S&T projects according to their mission requirements.
- By implementing the management structure and recommendations of the Master Plan, DOD has increased collaboration among the HEL community and provided more opportunities for coordination of HEL efforts.

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Objective 1: Has DOD Achieved a Better Balance Between Large Demonstration Programs and Enabling S&T Projects?

- The HEL JTO funds service and agency projects and also projects carried out by industry and academia
- Each of the services, the Missile Defense Agency and the Defense Advanced Research Projects Agency have separate HEL S&T projects exploring the technological challenges of HEL weapons
- The Army, the Missile Defense Agency, and the Special Operations Command are also developing large-scale demonstration programs to provide HEL weapon system capability to the warfighter

The large demonstration programs are system-specific programs, while the enabling S&T projects are independent of a specific application.

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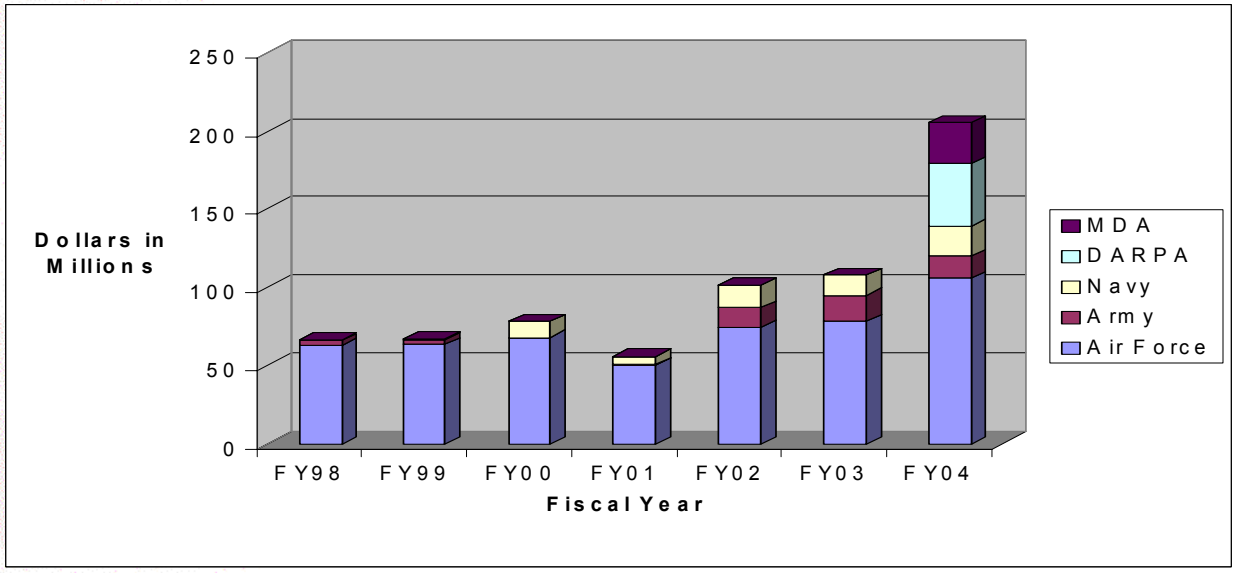
Objective 1: Funding for Service and Agency HEL S&T Technology Base Has Increased



Expenditures less than $1.0 million do not show on the graph above. In FYs 1998/99, the Navy expended funds for HEL S&T, but the total each year was less than $1.0 million; likewise for the Army in FY 2001.

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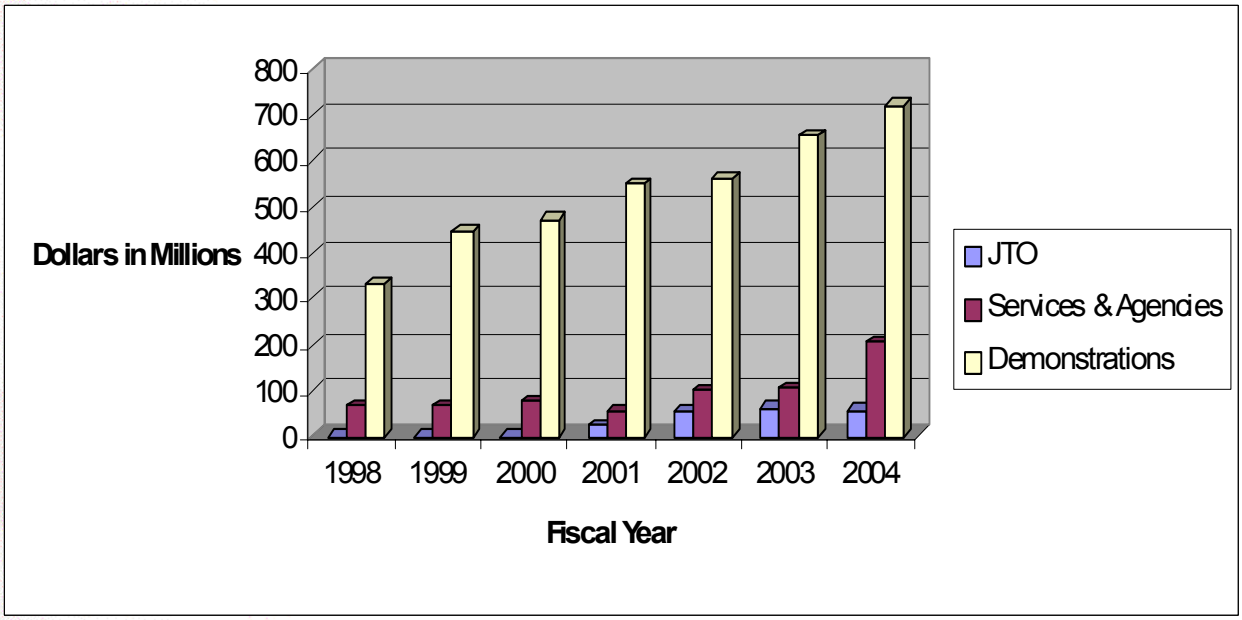
Objective 1: Funding for JTO & Service/Agency S&T Technology Base vs. Large-Scale Demonstrations



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Objective 1: Definition of DOD S&T Budget Activities

- Definitions of Science and Technology categories
  - **Basic research (budget activity 6.1):** Research that increases fundamental knowledge in a scientific or technology area without application to a specific product
  - **Applied research (budget activity 6.2):** Studies, investigations and non-system-specific technology efforts that are directed toward general military needs in order to evaluate the feasibility and practicality of proposed solutions
  - **Advanced Technology Development (budget activity 6.3):** Development of subsystems and components for field experiments and efforts to integrate them into system prototypes for field experiments and/or tests in a simulated environment; includes the HEL demonstration programs

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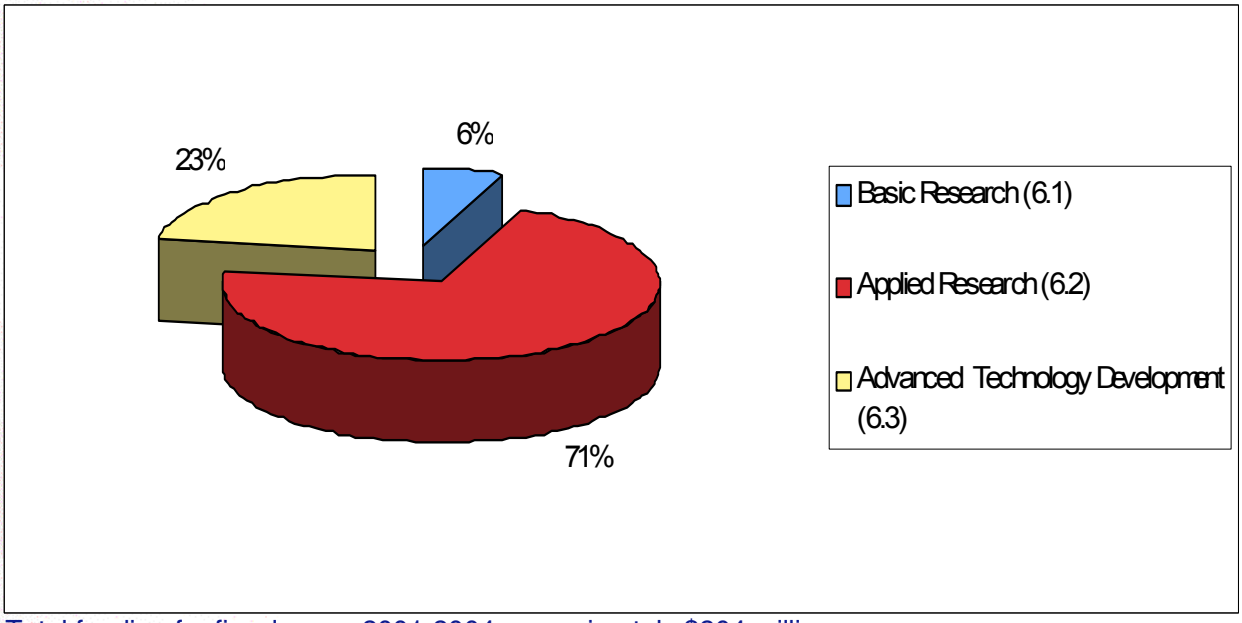
Objective 1: JTO HEL-Related Funding FY 2001-2004 by Funding Type



Total funding for fiscal years 2001-2004 approximately $204 million.

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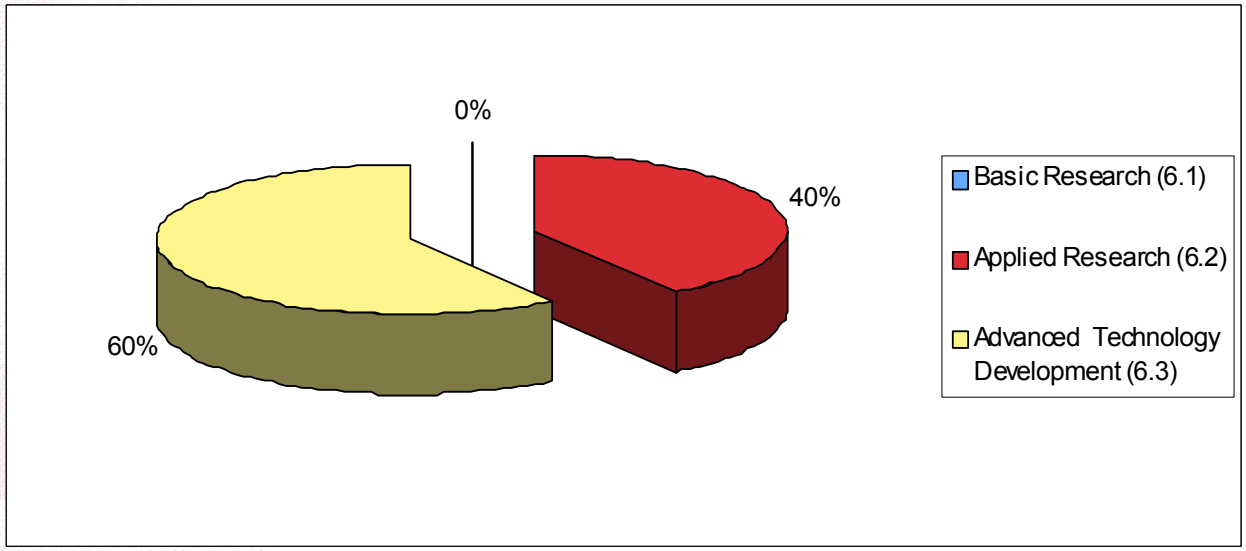
Objective 1: Service/Agency HEL Technology Base Funding FY 1998-2004 by Funding Type



Total funding for fiscal years 1998-2004 about $691 million. Does not include funding for large demo programs.

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Objective 1: Observations

- All services and agencies have significantly increased their HEL technology base funding since the 2001 Defense Authorization Act
- Since the HEL Master Plan of 2000 recommended the DOD remedy the imbalance between demonstration programs and enabling science and technology base projects, the imbalance has decreased, for example, in:
  - 1998: Service/Agency technology base HEL funding was about 17 percent of the total, or $66.4 million, while the demonstration programs received $331.8 million.
  - 2004: Service/Agency technology base and JTO HEL funding was about 27 percent of the total, or $262.9 million while the demonstration programs received $720.1 million

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Objective 2: Does the DOD Funding Process Focus on the Most Critical HEL Issues?

- Since the HEL Master Plan and subsequent legislation, DOD has increased its funding of critical HEL-related technology
  - DOD's JTO has a process for focusing its funding on what it determines are the most critical HEL issues
  - The services and the Missile Defense Agency HEL S&T funding focuses on developing and incorporating technologies related to their intended platform use
  - The Defense Advanced Research Projects Agency funds basic research into HEL-related high risk, high payoff technologies

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Objective 2: JTO Prioritized the HEL-related Technologies

- The JTO used four criteria to prioritize technologies critical to future HEL applications
  - Overall impact on HEL missions: potential for significant effect
  - Ripeness: appropriate level of maturity
  - Cost appropriateness: work matches expected funds
  - Breadth of area: multiple applications or multiple services
- Using these criteria, technologies were evaluated by a wide range of experts in HEL field, including the military and industry

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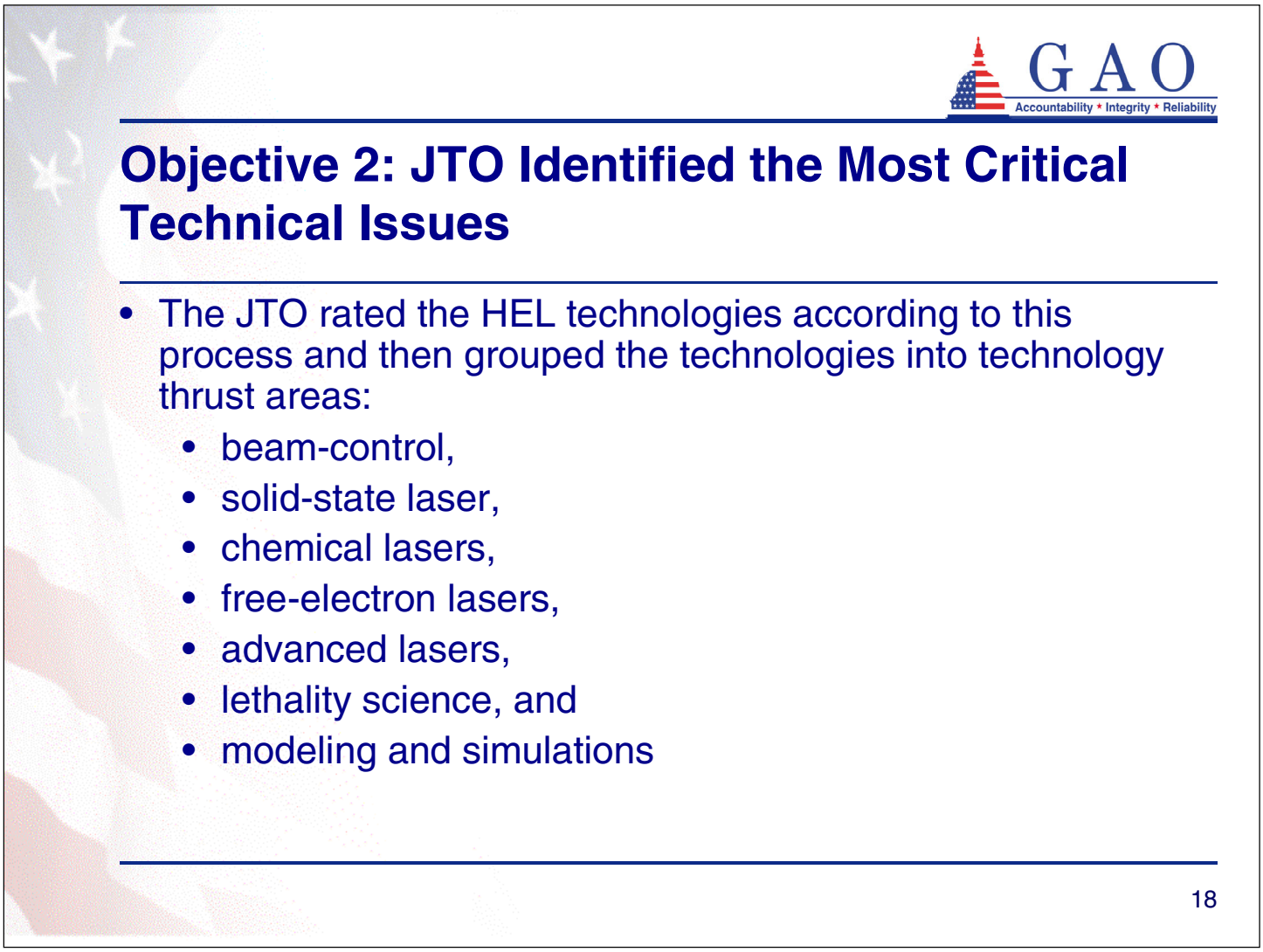
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Objective 2: JTO Identified the Most Critical Technical Issues
• The JTO rated the HEL technologies according to this process and then grouped the technologies into technology thrust areas:
• beam-control,
• solid-state laser,
• chemical lasers,
• free-electron lasers,
• advanced lasers,
• lethality science, and
• modeling and simulations
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Objective 2: JTO Funds Its Projects According to the Priorities Set

- The JTO has used these priorities to fund its projects since 2001
- Funding for each thrust area is based on:
  - Relative importance of the area and amounts needed to make progress
  - The need to either complement service HEL efforts or to fill in gaps in service coverage
- The JTO, services, and Technology Area Working Groups meet annually to review their investments in each thrust area and determine way forward

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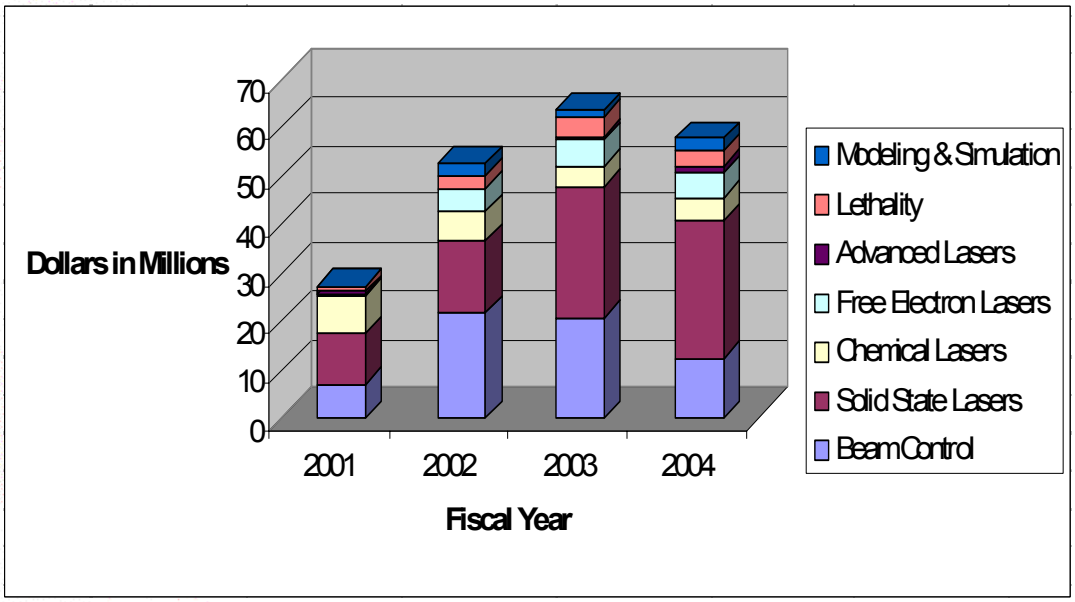
Objective 2: JTO Funds the Technologies They Identified as Most Critical



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Objective 2: Services and Missile Defense Agency Fund HEL-Related Technologies Based on Their Intended Use

- Services and the Missile Defense Agency fund HEL S&T based on their mission requirements
- Service and agency HEL-related S&T does not follow the priorities established by the JTO

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Objective 2: Services and Missile Defense Agency HEL-Related Activities Are Focused on Their Intended Platforms

Service	Requirements	S&T Focus
Army	Develop laser technologies that can be incorporated into Army weapon system	Solid state lasers
Navy	Develop and incorporate technologies based on use on electric ships, submarines, or aircraft	Free-electron lasers, solid state lasers and beam control for naval environment
Air Force	Develop and incorporate laser technologies for space and airborne platforms	Space and airborne lasers
Missile Defense	Support next generation Airborne laser	Airborne laser

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Objective 2: Observations

- The JTO's process for establishing priorities is clearly defined, objective, and based on input from a wide range of experts
- The JTO follows these priorities when allocating their funding
- The JTO does not direct services' and agencies' HEL S&T projects or funding
- The services and agencies fund HEL S&T projects which focus on their mission needs

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Objective 3: What Impact Have the HEL Technology Council and JTO Had on the Coordination of HEL Technology Development Efforts DOD-Wide?

- In implementing Section 242 of the 2001 Defense Authorization Act, DOD has provided more opportunity for coordination of HEL efforts, both at the service and agency S&T executive level and the working level:
  - The DOD Technology Council has oversight and approval authority over the JTO funding, while its members direct the HEL activities of their respective service or agency
  - The JTO acts as a focal point within the DOD for HEL coordination and advocacy:
    - Membership of the JTO includes full-time service representatives and part-time agency representatives
    - Membership in the Technology Area Working Groups include JTO, service, agency and industry representatives

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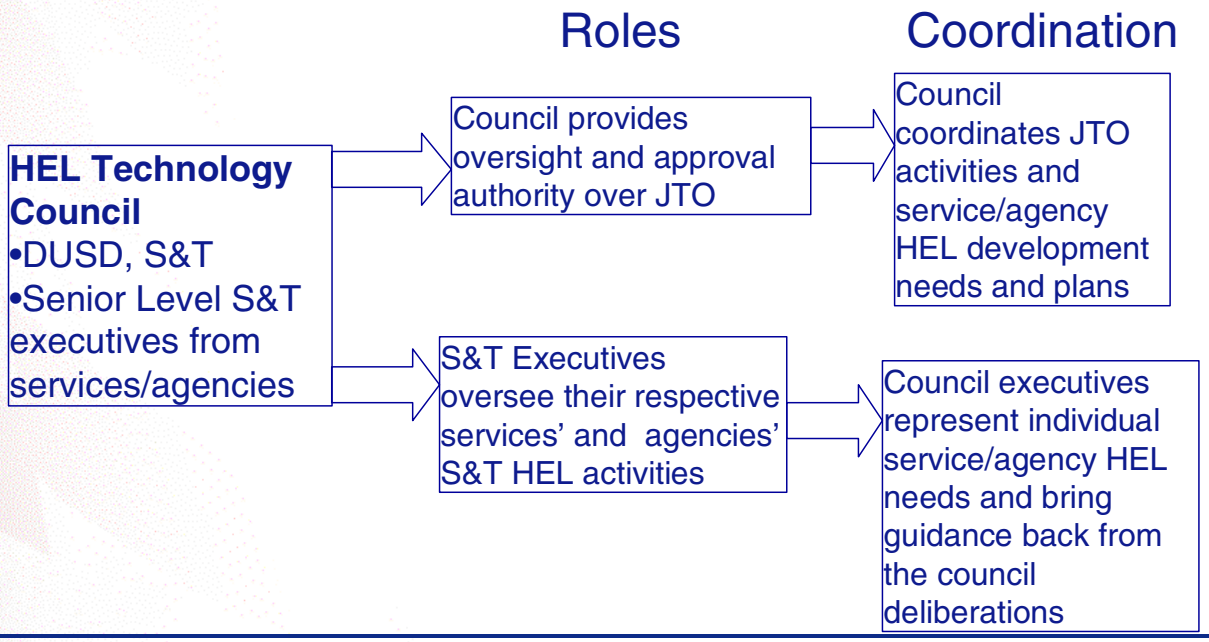
Objective 3: Technology Council Coordinates HEL Efforts



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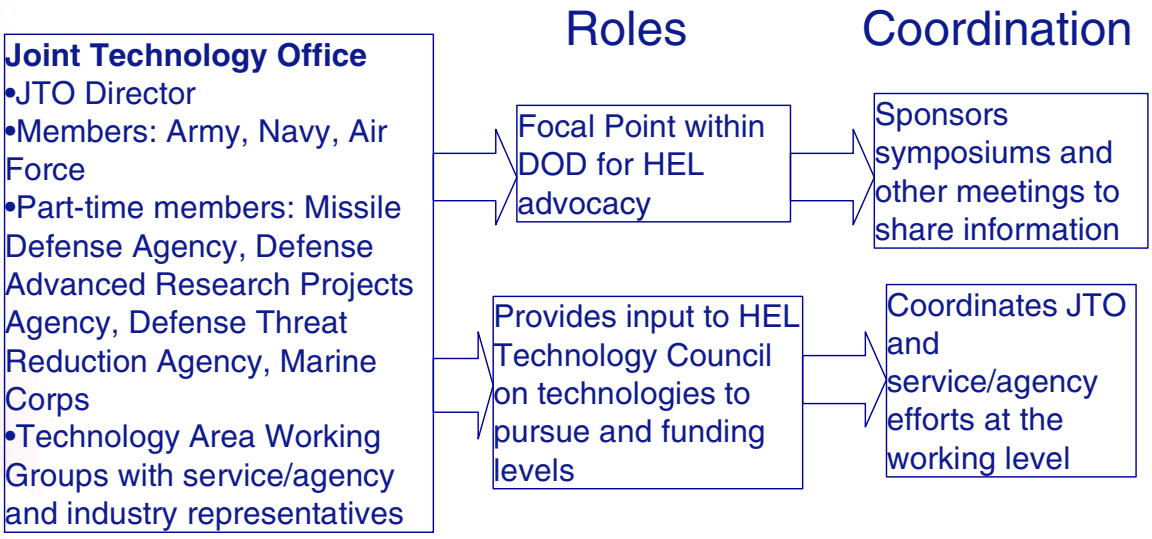
Objective 3: JTO Provides a Focal Point for HEL Efforts



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Objective 3: HEL Technology Council Provides Oversight and Guidance

- Concerning the Joint High Powered Solid State Laser project, the HEL Technology Council directed the JTO to continue current effort before proceeding to the next phase in order to:
  - Give contractors additional time to deliver best product
  - Ensure the services understand how the current level fits their needs
  - Allow other technologies opportunity to enter into the decision
- Directed greater cooperation between services and Defense Advanced Research Projects Agency on fiber lasers effort and High Energy Liquid Lasers Area Defense System
- Action requested by the Council Chair to explore opportunities for basic research

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Objective 3: No Redundancy in HEL-Related Activities

- No apparent examples of redundant projects in JTO funding
  - Some projects explore same technology, but different solutions or applications
    - For example, the JTO sponsored 4 beam control component projects with similar titles but different applications
    - Air Force and Navy also have beam control component projects, which focus on mission-related applications, while the JTO pursues more generic technology

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Objective 3: Examples of JTO and Service Beam Control Projects

Service	Project Title	Description
JTO Air Force sponsor	Optical component technology	Athermal subscale window
JTO Army sponsor	Alternate HEL windows	Evaluate a type of window material
JTO Navy sponsor	Tactical conformal window development	Fabrication of large tactical conformal windows
JTO Navy sponsor	High reflective coating	Develop optical coatings that can withstand high power
Air Force	Airborne laser beam control	Refine beam control for airborne platforms
Navy	Beam control	Investigate effects of aerosols, water vapor, and air turbulence on laser beam in maritime environment

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Objective 3: Observations

- The Technology Council coordinates and oversees the activities of the JTO and provide some direction to services on the direction of their HEL-related activities
- The Technology Council's individual members direct the HEL S&T efforts of their respective service or agency
- Through Technology Area Working Groups and symposia, the JTO brings the DOD HEL community together providing:
  - Increased awareness of ongoing activities
  - Insight into technical challenges common to all HEL projects
- The JTO avoids duplicating service efforts and does not fund redundant projects

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Scope and Methodology

- Reviewed the HEL Master Plan and the subsequent legislation and interviewed officials in the Office of the Secretary of Defense to assess DOD's implementation of the plan's recommendations
- Interviewed HEL JTO officials and reviewed documents to assess their implementation of the HEL Master Plan recommendations and their criteria for prioritizing and funding HEL technologies
- Interviewed Army, Navy, Air Force, Missile Defense Agency, and Defense Advanced Research Projects Agency officials involved in HEL efforts and reviewed pertinent documentation to assess how they determine their priorities and funding for HEL programs and projects
- Reviewed funding documentation for all service and agency HEL projects from 1998 to 2004 and JTO funding from 2001 to 2004
- Reviewed active projects the JTO sponsored for possible duplication with service/agency projects and, for projects that seemed similar to each other, performed a more in-depth analysis of the projects
- We obtained oral comments from DOD on a draft of this presentation
- We conducted our review from August 2004 to April 2005 in accordance with generally accepted government auditing standards

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Enclosure II: Comments from the Department of Defense

OFFICE OF THE DIRECTOR OF
DEFENSE RESEARCH AND ENGINEERING
3040 DEFENSE PENTAGON
WASHINGTON, DC 20301-3040

MAY 10 2005

Mr. Paul L. Francis
Director, Acquisition and Sourcing Management
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Francis:

This is the Department of Defense (DoD) response to the GAO draft report, "HIGH ENERGY LASERS: Department of Defense Initiatives On High Energy Lasers Have Been Responsive to Congressional Direction," dated April 14, 2005 (GAO Code 120369/GAO-05-545R).

The Department appreciates the opportunity to review the draft report and has no comments.

Sincerely,

Spiro G. Lekoudis, Ph.D.
Director
Weapons Systems

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